Marks: 70
Time: 2.00 hrs   Hall Ticket no: [   ]

I. Write your Hall Ticket Number on the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the Space provided above.
II. Read the following instructions carefully before answering the questions.
III. This Question paper has TWO parts: PART 'A' AND PART 'B'

1. Part 'A': It consists of 20 questions of **1.75** marks each.
   There is a negative marking of **0.50** marks for every wrong answer.
2. Part 'B: It consists of **35** questions of one mark each with no negative marking.
3. All questions are to be answered. Answers for these questions are to be entered on the OMR sheet, filling the appropriate circle against each question. For example, if the answer to a question is D, it should be marked as below:

$$\text{(A)} \qquad \text{(B)} \qquad \text{(C)} \qquad \bullet$$

No additional sheets will be provided. Rough work can be done in the question paper itself.

4. Hand over the OMR answer sheet to the invigilator at the end of the examination

5. Mobile phones, log tables and calculators of any type are NOT permitted inside the Examination Hall.

6. This book contains 14 pages including this cover sheet.

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PART A

1. sin (x+iy) =

    A. cosx coshy + i sinx sinhy
    B. sinx coshy - i cosx sinhy
    C. coshy - i sinhy
    D. sinx coshy + i cosx sinhy

2. Which of the following is <u>not</u> TRUE for an exponential function e^z in terms of functions e^x, cosy and siny?

    A. e^z is analytic only at $z = 0$
    B. $e^z = e^x$ (cosy + i siny)
    C. $e^z = e^x$ for real z = x because cosy = 1 and siny = 0 when y = 0
    D. The derivative of $e^z = e^z$

3. Two liquids X and Y are mixed in a container in the ratio 7:5 by volume. When 9 litres of the mixture is drawn off the container and again filled with liquid Y, the ratio of X and Y becomes 7:9. How many litres of liquid X was contained initially in the mixture?

    A. 11 litres
    B. 15 litres
    C. 21 litres
    D. 24 litres

4. If $3^{(a-b)} = 27$ and $3^{(a+b)} = 243$, then b = ?

    A. 3
    B. 4
    C. 5
    D. 1

5. The ratio of the current ages of RD and DD is 2:3, which becomes 5:6 after 3 years. What is the age of RD after 5 years?

    A. 7 years
    B. 5 years
    C. 8 years
    D. 9 years

6. 'X' can complete a work in 10 days while 'Y' can complete the same in twice the days taken by 'X'. If X and Y work together for 3 days, then the fraction of work that will be left is?

    A. 9/20
    B. 3/20
    C. 11/20
    D. 17/20

7. If an error of +4% is made while measuring the side of a square, then the percentage of error in calculating the area of the square is

    A. 2%
    B. 8.16%
    C. 2.16%
    D. 16%

8. A laboratory is L m long and L/2 m broad. If the sum of the areas of the floor and the ceiling is equal to the sum of the areas of four walls, then the volume of the laboratory is

    A. $L^3/6 \ m^3$
    B. $L^3/2 \ m^3$
    C. $L^3/3 \ m^3$
    D. $L^3 \ m^3$

9. Consider three consecutive odd integers. If 3 times the first of these integers is 3 more than 2 times of the third integer, then the second integer is

    A. 11
    B. 15
    C. 13
    D. 17

10. In a 20-20 international cricket match, India scored at a rate of 6.2 runs per over in the first 10 overs. What should be the rate at which India should score in the final 10 overs so that the score can reach 262?

    A. 10
    B. 20
    C. 15
    D. 22

11. If the average of 20 numbers is 0, then among the 20 numbers, at the least how many numbers should be negative?

    A. 19
    B. 0
    C. 2
    D. 1

12. If University of Hyderabad's library has been visited by 500 and 300 students on an average on every Monday and every other day, respectively, of April 2019, which has 30 days beginning with a Monday, then the average number of students who visited the library per day in April was:

    A. 33.33
    B. 300
    C. 333.33
    D. 400

13. In an examination Sita scored 10 marks more than what Gita scored and the marks scored by Sita are 60% of the total marks scored by Sita and Gita together. How many marks did Gita score?

    A. 60
    B. 30
    C. 50
    D. 20

14. If M = x% of y and N = y% of x, then

    A. M > N
    B. M = $\sqrt{N}$
    C. M < N
    D. M = N

15. Dr. Scientist plans to purchase chemicals worth Rs.10000/-. The supplier offered a discount of 10% but Dr. Scientist has to pay a tax of 10% on the discounted price. The amount spent by Dr. Scientist on purchasing the chemicals is

    A. Rs.9900/-
    B. Rs.10000/-
    C. Rs.9990/-
    D. Rs.11000/-

16. The time of a flight is increased by an hour in comparison to the original flight time due to reduced average speed of 100 km/h. What is the original flight duration if the distance travelled is 600 km?

    A. 4 h
    B. 2 h
    C. 3 h
    D. 1 h

17. What is the unit digit in $\{(125)^{125} \times (652)^{1963} \times (351)^{81} + 1\}$

    A. 0
    B. 2
    C. 1
    D. 5

18. If x m^2 of a cloth is costing Rs.a/-, then how much does y m^2 of the same cloth cost at the same rate?

    A. Rs.(ay/x)/-
    B. Rs.(xay)/-
    C. Rs.(xa/y)/-
    D. Rs.(xy/a)/-

19. A person walked at the rate of 5 km/h for a certain distance and then bicycled at a rate of 8 km/h to reach the destination which is 81.6 km from the starting point. If the person took 12 h in total to reach the destination, then what is the distance the person bicycled?

    A. 19.4 km
    B. 56.4 km
    C. 19.6 km
    D. 57.6 km

20. The next number in the sequence 5, 18, 67, 260, ? is

    A. 335
    B. 1040
    C. 513
    D. 1029

PART B

21. An electron in a ground state atom jumps into the first excited state for a short time at absolute zero temperature. What is the lifetime of this excitation (or this quantum-mechanical electron transfer process) if the energy difference between the ground and first excited state is 2.07 eV? [Note: Planck's constant is given by 4.14 x 10^{-15} eV-sec]

    A. 8.5 x 10^{-12} sec
    B. 2 x 10^{-10} sec
    C. 2 x 10^{-15} sec
    D. 4.14 x 10^{-12} sec

22. A capacitor is considered to be fully charged

    A. when current through the capacitor is one fourth of the current when it is discharged
    B. when current through the capacitor is one third of the current when it is discharged
    C. when current through the capacitor is half that of the current when it is discharged
    D. when current through the capacitor is equal to the current when it is discharged

23. As per Compton effect, the greatest wavelength change occurs when the photon is scattered (by a particle of rest mass) through an angle equal to

    A. 90°
    B. 180°
    C. 270°
    D. 360°

24. Ultraviolet light with a quantum energy of 3.6 eV is incident on a metal surface having a work function of 1.6 eV. What is the maximum energy of the photoelectrons ejected from the metal surface?

    A. 1.6 eV
    B. 1.8 eV
    C. 2.0 eV
    D. -2.0 eV

25. Consider the following properties/behavior of a solid

        1. Ferromagnetism   2. Optical band gap   3. Ferroelectricity

The property/properties which is/are dependent on dimensions of the solid is/are

    A. 1, 2 and 3
    B. 1 only
    C. 1 and 2 only
    D. 2 only

26. If a neutron beam is incident on a crystalline solid in which the interplanar distance is 1.2 Å then what is the energy of the neutron diffracted from the solid angle of 30°, assuming first order diffraction?   [neutron mass = 1.67×10^{-27} kg]

    A. 0.68 eV
    B. 0.068 eV
    C. 0.046 eV
    D. 0.057 eV

27. The energy of photon emitted by a Bohr atom making a transition from a state with quantum number = 5 to a state with quantum number = 4 is

    A. 0.068 eV
    B. 0.68 eV
    C. 0.5 eV
    D. 0.3 eV

28. Which of the following statements is correct w.r.t the contribution of phonons to heat capacity?

    A. At low temperatures only acoustic and at high temperatures both acoustic and optical phonons contribute
    B. At low temperatures only optical phonons contribute
    C. At low temperatures both acoustic and optical phonons and at high temperatures only acoustic phonons contribute
    D. Only acoustic phonons contribute, independent of temperature

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29. If 0.65g of Zn (atomic weight of Zn is 65) reacts with diluted H_2SO_4 at NTP conditions, then how much of H_2 is evolved?

    A. 2.24 cm^3

    B. 22.4 cm^3

    C. 224 cm^3

    D. 2240 cm^3

30. A double slit apparatus is immersed in a liquid of refractive index 1.33. If one of the slits is covered by a thin film of refractive index 1.53, the smallest thickness, t, of the film required to bring the adjacent minimum to the axis is

    A. 0.2t

    B. 1.33t

    C. 0.15t

    D. 1.53t

31. A small solid sphere of radius r, falls from rest in a viscous liquid and heat is produced due to friction. The rate of heat production at the terminal velocity is proportional to

    A. r

    B. r^2

    C. r^3.

    D. r^5

32. A simple pendulum has time period T_1. The point of suspension is moved upward according to the relation $y = kt^2$ ($k = 1m/s^2$). y is the vertical displacement. If the time period is now T_2, then $(T_1)^2/(T_2)^2 = \underline{?}$ (Given $g = 10m/s^2$)

    A. 1

    B. 5/6

    C. 6/5

    D. 4/5

33. A 0.2wt% plain carbon steel sheet is heated and equilibrated in the inter-critical region followed by instant water quenching. The microstructure of the quenched steel consists of

    A. only martensite

    B. proeutectoid ferrite + martensite

    C. proeutectoid martensite + ferrite

    D. martensite + pearlite

34. A substance is at its triple point. If the pressure on the substance is now increased, then the triple point

    A. remains unaltered independent of substance
    B. increases independent of substance
    C. decreases independent of substance
    D. increases or decreases depending on the substance

35. If the lattice parameter of FCC unit cell of Al is 4Å, then how many unit cells are there in an Al foil of 0.004 cm thickness and sides each of length 16 cm?

    A. 1.6×10^{22}
    B. 1.6×10^{23}
    C. 1.6×10^{24}
    D. 1.6×10^{25}

36. An electron having a de Broglie wavelength of 0.12nm is confined in a 1D quantum box. If 4 loops of the de Broglie wave span from one wall to the other of the box, then the distance between the wall is

    A. 1.2 Å
    B. 2.4 Å
    C. 0.24 Å
    D. 0.12 Å

37. The band gap of a semiconductor is 1.98 eV. What is the color of the emitted radiation from the semiconductor when electrons and holes in the semiconductor recombine directly?

    A. yellow
    B. red
    C. green
    D. blue

38. If the lattice constant of the unit cell of BCC α-Fe is 0.287 nm, then the number of atoms/mm^2 of the crystallographic plane (100) is

    A. 1.21×10^{12}
    B. 1.21×10^{13}
    C. 12.1×10^{13}
    D. 1.21×10^{14}

39. The average energy per molecule at 300K is

    A. the same for all gaseous molecules, regardless of their mass
    B. the same for only low molecular weight gas molecules
    C. the same for only high molecular weight gas molecules
    D. different for different molecules due to differences in their masses

40. Burgers vector of a BCC crystal with a lattice constant of 0.33 nm is

    A. 0.33 nm
    B. 0.285 nm
    C. 0.504 nm
    D. 0.466 nm

41. For an ideal binary solution AB, if mole fraction of A, $X_A = 0.248$, then the molar entropy of mixing $\Delta S_{mix} =$?   (given R = 8.314 J/K.mol)

    A. 7.66 J/K.mol
    B. 6.66 J/K.mol
    C. 5.66 J/K.mol
    D. 4.66 J/K.mol

42. X-ray spectra of elements were historically used to arrange elements in the periodic table according to

    A. atomic weights
    B. atomic numbers
    C. ionic radius
    D. valency

43. In the molecular-orbital approach, the number of bonds in a molecule is equal to

    A. (electrons in bonding orbitals) − (electrons in antibonding orbitals)
    B. (electrons in bonding orbitals) + (electrons in antibonding orbitals)
    C. {(electrons in bonding orbitals) − (electrons in antibonding orbitals)}/2
    D. {(electrons in bonding orbitals) + (electrons in antibonding orbitals)}/2

44. The region in k-space (wave vector space) that low-k electrons can occupy without being diffracted is the

    A. second Brillouin zone
    B. first Brillouin zone
    C. refraction region
    D. reflection region

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45. As the temperature of a non-metallic amorphous solid is increased, its thermal conductivity

    A. increases
    B. decreases
    C. is unaltered
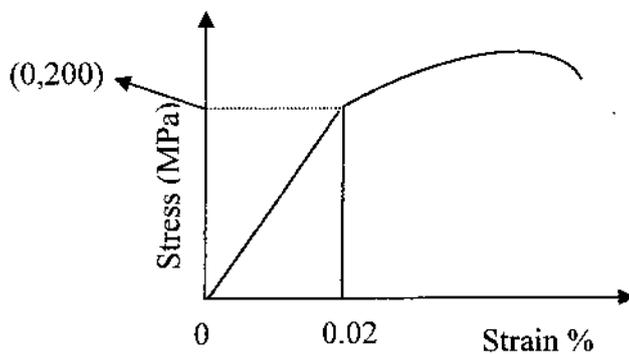   D. initially decreases to some extent and then exponentially increases

46. A cycle constituted by two isentropic processes, one constant pressure, and one constant volume is called as

    A. Otto cycle
    B. Diesel cycle
    C. Carnot cycle
    D. Stirling cycle

47. For an isotropic and homogenous solid with Poisson's ratio υ, the relationship between its Young's Modulus (E) and shear modulus (G) is given by

    A. $G = E/2(1+\upsilon)$
    B. $E = G/2(1+\upsilon)$
    C. $G = 2E/(1+\upsilon)$
    D. $G = 2E/(2+\upsilon)$

48. What is the resilience of a material whose characteristic stress-strain behavior is given in the following curve?

    A. 4 MPa
    B. 2 MPa
    C. 200 MPa
    D. 100 MPa

49. If the sequence of diffraction peaks represented by Miller indices in an X-ray diffraction pattern of a single phase polycrystalline metal is given by P, (200), (220), (311) and (222), then what is P?

    A. (111)
    B. (110)
    C. (100)
    D. (101)

50. In a Cu-Zn diffusion at 573 K for 8 h a certain concentration profile was obtained. Calculate the time required to achieve the same concentration profile at 473 K. The diffusion coefficients of Zn in Cu at 573 K and 473 K are 2×10^{-11} m^2/sec and 4×10^{-12} m^2/sec, respectively.

    A. 10 h
    B. 20 h
    C. 30 h
    D. 40 h

51. If ΔH = heat of mixing and ΔV = volume change on mixing for an ideal solution, then which of the following is correct if the solution obeys Raoult's law?

    A. ΔH is positive while ΔV is negative
    B. Both ΔH and ΔV are negative
    C. Both ΔH and ΔV are positive
    D. $\Delta H = 0$, $\Delta V = 0$

52. In the case of an ideal solution, how does the total vapor pressure vary with respect to composition expressed in mole fraction?

    A. is invariant
    B. exponentially
    C. inversely
    D. linearly

53. According to Wiedemann-Franz law, the ratio of the electronic contribution to the thermal conductivity to the electrical conductivity at a temperature T is (k= Boltzmann constant, e is the electronic charge)

    A. $(\pi^2/3)(k/e)^2 T$
    B. $(\pi^2/3)(k/e) T^2$
    C. $(\pi/3)(k/e)^2 T$
    D. $(\pi^2/3)(k/e)^2 (1/T)$

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54. What is the work done during a free expansion process?

    A. Positive
    B. Negative because it is a free process
    C. Zero
    D. Infinite because it is a free process

55. Standard Temperature Pressure (STP) condition is

    A. 760 Torr and 0 °C
    B. 760 mm Hg pressure and 15.5 °C
    C. 1 atm absolute pressure and 15.5 °C
    D. 1 atm absolute pressure and 25.5 °C

University of Hyderabad
Entrance Examinations - 2019

School/Department/Centre : School of Engineering Sciences and Technology
Course/Subject : Ph.D. (Nanoscience and Technology)

Question Number	Answer	Question Number	Answer	Question Number	Answer
1.	D	24.	C	47.	A
2.	A	25.	A	48.	B
3.	C	26.	D	49.	A
4.	D	27.	D	50.	D
5.	A	28.	A	51.	D
6.	C	29.	C	52.	D
7.	B	30.	C	53.	A
8.	A	31.	D	54.	C
9.	C	32.	C	55.	C
10.	B	33.	B		
11.	D	34.	A		
12.	C	35.	A		
13.	D	36.	C		
14.	D	37.	B		
15.	A	38.	B		
16.	B	39.	A		
17.	C	40.	B		
18.	A	41.	D		
19.	D	42.	B		
20.	D	43.	C		
21.	C	44.	B		
22.	D	45.	A		
23.	B	46.	B		